PN-ABP-148
82508

PRITECH
Technologies for Primary Health Care

Management Sciences for Health
1925 North Lynn Street
Suite 400
Arlington, Virginia 22209

RX DRUG USE ANALYSIS SYSTEM: DEVELOPMENT AND APPLICATION OF A TOOL FOR MEASURING AND MONITORING DRUG USE PRACTICES

A Report Prepared by PRITECH Consultant:
JIM BATES
JIM RANKIN
DENNIS ROSS-DEGNAN

During The Period:
JUNE 1991

TECHNOLOGIES FOR PRIMARY HEALTH CARE (PRITECH) PROJECT
Supported By The:
U.S. Agency for International Development
CONTRACT NO: AID/DPE-5969-Z-00-7064-00
PROJECT NO: 936-5969

AUTHORIZATION:
AID/S&T/HEA: MAY 13, 1993
ASSGN NO: HSS 111-IR

1. PURPOSE

The purpose of this proposal is to secure funding for developing and applying a system for the collection and analysis of drug use data, to be called the *Rx Drug Use Analysis System*. In brief, the system will consist of a set of standardized procedures for studying drug use practices in a variety of settings and for different purposes, and an integrated software package that will allow for the input, processing, and analysis of these data. This system will be based on, but will significantly extend the capabilities of, the existing RxDD Prescribing for Diarrheal Disease system.

Rx will integrate database and graphics functions for analyzing and reporting on drug use encounters in both public and private health care settings, including:

- Distribution of health problems in a sample of patient encounters;
- Frequency of use, dosing, and costs of drugs used to treat any health problem;
- Other non-pharmaceutical services provided during patient encounters;
- Differences in these parameters among service providers, between facilities or areas, and over time.

Once the software and documentation for the system are developed, it will be applied to different health care management problems in six country settings. Lessons learned on sample design, data collection and coding, and personnel training will be incorporated into the system's documentation. The goal of this activity is to provide USAID with a practical tool for management and research, suitable for use in any country environment, that allows quantitative measurement of both the quality and cost of pharmaceutical health care services.

2. BACKGROUND

2.1. The Problem of Irrational Drug Use

The last fifteen years have seen considerable progress in the areas of product selection, procurement and distribution of essential drugs in developing countries. As management systems in these areas are improved and consolidated, concern is shifting to the ways in which drugs are actually used by health care providers. No matter how much progress is made in logistics management, if drugs are prescribed and dispensed irrationally, then the contribution of these important resources to improving health status will be significantly constrained.

Studies in both industrialized and developing countries have documented less than optimal

drug prescribing and dispensing practices for a number of priority health problems. The studies show that a broad range of care providers participate in these inappropriate practices, including doctors and paramedical staff in ministry of health clinics, doctors in private practice, and pharmacists and other retail drug sellers. The diverse nature of inappropriate drug use is illustrated by the following examples:

- *Diarrheal Treatment in Public Sector Health Centers*: A survey of health centers in one district in Indonesia found that at some health centers less than half of the children diagnosed with simple watery stool diarrhoea received ORS, while over 80% received hydroxyquinoline, a so called "antidiarrheal" product associated with dangerous side effects such as myelo-optic neuropathy.[1] The same study found that the average child received 1.7 antibiotic products, usually an injection of tetracycline accompanied by a sub therapeutic dose of the same drug in capsule form.

- *Acute Respiratory Infections in Hospitals*: Of 3813 children admitted to a pediatric teaching unit in Kuwait, 19% received antibiotics therapeutically or prophylactically.[2] Antibiotic use was unnecessary in 282 children, 203 of which had respiratory infections. Prescribing errors were found in 352 cases,- 68% of which were in respiratory infections and 86% of which involved a penicillin. A departmental policy for the use of antibiotics in gastroenteritis led to their use in only 4% of cases. A written justification for cefotaxime reduced its use by 90%. The lack of similar policies for antibiotic use in respiratory infections leads to high rates of antibiotic use and misuse worldwide.

- *Over-the-Counter Antibiotics*: A study in drugstores in Manila found that antimicrobial agents accounted for 20.1% of all drug purchases.[3] Purchases were made without prescription in 66.3% of 1608 transactions. Most of these were aminopenicillins or penicillins G or V (40.0%). The most common perceived indications were respiratory tract infections (20.2%), tuberculosis (8.8%), "prophylaxis" (8.6%) and gastrointestinal infection (8.3%). Almost 90% of purchases were for 10 or less capsules or tablets. The median number of units purchased was 3. These practices can provide only limited clinical efficacy and favor emergence of resistant bacteria.

- *Injections and AIDS*: In Kinshasa, Zaire, children under the age of two who were in hospital were found to average over two dozen injections of various sorts before age two, and seropositivity for AIDS has been shown to be associated with lifetime injection frequency.[4]

- *Where Does the Penicillin Go?*: In a study of health post prescribing patterns

in a hill district in Nepal, an average of 2.9 drugs were dispensed per patient visit. One-half of all procaine penicillin injections -- the most commonly prescribed treatment in the district -- were found to be given for skin conditions, very few or none of which can benefit from injectable antibiotics.[5]

Inappropriate drug use, as illustrated by these examples from different countries and health settings, is a widespread and complex phemomenon, but one which can often be defined in terms of specific practices:

- Under-use of appropriate drugs when they are indicated;
- Incorrect dosing (either in excessive or sub-therapeutic doses) of appropriate drugs;
- Failure of patients to comply with recommended administration;
- Use of drugs with toxic side effects where alternatives are available;
- Use of unnecessary or ineffective drugs;
- Use of unnecessarily expensive drugs when cheaper alternatives are available.

Taken together, these practices add up to low quality health care and waste of scarce pharmaceutical resources. Improving the ways in which health care providers use drugs is an important opportunity area for strengthening child survival and primary health care services.

2.2. Role of Drug Use Analysis

The capacity to efficiently analyze prescribing and dispensing data and make quantitative summaries of prevailing practices is one key to evaluating the appropriateness of drug use and deciding how to intervene to improve observed problem practices.

Policy makers and managers wishing to make improvements have a number of options for influencing practice in both the public and private sectors. Possibilities for intervention include:

- Regulations that ban or limit availability of, or access to, inappropriate products;
- Managerial measures that monitor and control the use of drugs;

- Educational or communications programs that seek to influence prescribers, dispensers, or patients to use drugs in certain ways.

Examples of educational or communications interventions include:

- Reform of medical and pharmacy school curricula;
- In-service training programs;
- Work shops, such as those provided by professional associations;
- Newsletters and technical bulletins;
- Detailing, or face to face encounters for promoting appropriate products and discouraging the use of inappropriate ones;
- Education materials or mass media promotion of good treatment practices aimed directly at consumers.

Research has shown that some interventions are more promising than others. For example, there is little reason to believe that newsletters by themselves do much to improve prescribing behavior. On the other hand, pharmaceutical manufacturers and academic outreach programs have amply shown that detailing is an effective means of persuading doctors and drug sellers that one product is better than another.

The best strategies for intervention will vary from setting to setting, depending on the audiences to be reached, and the resources available. However, whatever the intervention attempted, there are three needs that are constant:

- *Carefully identifying the drug use behaviors to change.* This is done by taking patient-specific and product-specific measures of practices from carefully selected groups of patients and providers. Clarity about types of patients, products, and quantities given is essential for formulating effective messages for change.

- *Accurately assessing the extent to which change takes place.* Properly evaluating the effectiveness of any intervention requires that practices be reliably measured both before and after an intervention, and in both an intervention and a control group. Comparison of these two groups in the direction and magnitude of their change from baseline to follow-up is an unbiased way to determine whether or not an intervention has been effective.

- *Periodic monitoring of the status of problem behaviors.* Once interventions have been tested and identified as effective strategies for change, they have to be systematically applied. Bringing about lasting change requires periodic monitoring of drug use practices and periodic reapplication of effective strategies.

The proposed *Rx* computer program is a tool that both managers and researchers will be able to use to help meet all of these needs.

2.3 How Does *Rx* Fit in with Work Already Under Way?

PRITECH has been working with quantitative analysis of drug use since 1988. This three-year period has seen considerable evolution in approaches for collecting and analyzing drug use data and illustrating results. To date, these efforts have progressed past three important milestones:

- *Producing major quantitative studies of drug use for child survival in Indonesia and Nepal*: These studies used proprietary database and graphics software, along with dBase-compatible data processing programs developed ad-hoc to meet their specific needs.

- *Developing a prototype program, called ORSMAP, that integrates data collection, data entry, data analysis, and standard graphics reporting functions*: This system, installed in the national CDD program in Indonesia, was developed to analyze supply management and drug use for diarrheal disease; the software was developed in non-proprietary compiled form in dBase-compatible Clipper, but graphics functions still rely on links to the proprietary Harvard Graphics.

- *Developing and field testing a refined version of the ORSMAP system, called RxDD*: This system, which retains a focus on drug use for diarrheal disease, has been adapted in its data collection methodologies, data structures, and language capabilities, to be more user-friendly and suitable for many different country environments; RxDD has been developed using a much more powerful and flexible version of Clipper, but still depends on links to Harvard Graphics.

Along the way, PRITECH has learned and documented many useful lessons related to analysis of pharmaceutical data, including: how to determine optimal sample sizes of sites and of patient encounters for analysis; how to efficiently collect and systematically code data using both retrospective and prospective methods; and how to train personnel to carry out the various tasks required for conducting drug use analysis and operating the required software.

As results of this work have been disseminated, it has become clear that there is considerable potential demand for a more versatile program with capacities not available in the diarrhea-focused RxDD program. The most important of these include additional capacities to:

- analyze data and produce reports for any specific morbidity or disease category, rather than just diarrheal disease;
- be able to profile morbidity patterns for a sample of facilities or of cases:
- be better able to manage and analyze longitudinal data for looking at issues like patterns in drug use practice over time or treatment of chronic diseases;
- collect and analyze a wider range of variables related to patient encounters, such as type of care provider, types of ancillary services given, or characteristics of the provider-patient consultation;
- be capable of producing a wider variety of user-defined reports incorporating the most relevant variables for a given situation, rather than being restricted to a pre-specified set of reports;
- integrate non-proprietary graphics procedures into the compiled system, and allow users flexibility in the selection of the results to present in graphic form.

RxDD was carefully designed to accommodate any additional programming required for later enhancements. Accordingly, the development of *Rx* should be viewed as an incremental investment in ongoing work, rather than as a "start from scratch" project.

3. PROJECT STRATEGY

The *Rx* project will have three phases, which will be implemented sequentially. They are:

1. Developing the *Rx* software and the preliminary system documentation, while taking an inventory of likely country applications;
2. Applying *Rx* in different ways and in different country settings;
3. Finalizing the system and documentation based on lessons learned from the country applications phase.

Details concerning these phases are given in Sections 4, 5 and 6 of this proposal and an illustrative schedule is appended as Annex A.

4. PHASE 1: DEVELOPING *Rx*

4.1. Programming Requirements

The programming required to implement the features envisioned for *Rx* will require both extensions to features currently available in RxDD, as well as the implementation of features new to the system. The following points describe the major steps to be taken in this process:

4.1.1. Extensions to Existing Features

1. The program will be expanded to allow analysis of a full range of health problems in addition to diarrhea; standardized reports will be added to profile the distribution of health problems, and to produce hierarchical versions of the current drug use report (RxDD Report 3) by health problem.

2. A mechanism will be added to allow the entry of a reasonable amount of additional user-defined information on the encounter, provider, or location; this information will be entered in a pop-up window accessed from the basic data entry screen via a function key.

3. A "verify to screen" option will be added to supplement the current verify to printer, allowing users to scan data without having to print them out; the verify feature will have additional flexibility in the selection of cases to verify.

4. Users will optionally be able to select a printer from a list of the most common printers, and codes for additional characteristics besides compressed print will be loaded automatically, notably, bold and underline; in this way, the appearance of reports can be further customized.

5. There will be a global edit function for all data and reference files, where all occurrences of a particular code can be changed to another code; the user will have the option of verifying each change before it is made, or automatically allowing all changes to take place.

6. A new interface will allow users to select and combine active databases from a data library menu listing all valid data files; among other things, this selection feature will enhance the efficient management of longitudinal files.

7. Column contents in reports will be allowed to vary from column to column, with each chosen separately by the user; data in individual columns could come from different databases and filters will be applied on a column-specific basis.

4.1.2. Incorporation of New Features

1. A new procedure will be added for defining standard treatments, consisting of specific drugs and amounts recommended to treat certain health problems; these standard treatments will be used to calculate "theoretical" use of drugs needed to treat a profile of health problems to be compared in reports to the observed drugs used to treat these problems.

2. Compiled presentation graphics will be integrated into the program using dGE; output files will be able to be scanned, and user will be able to identify ranges of data to be graphed by pointing and clicking on them.

3. A more fully developed setup procedure will be added with routines to: install the program on hard disk; select items from master drug and health problem lists distributed with the program; convert existing drug and problem lists to the *Rx* format; and guide users through the process of completing necessary information on drugs, therapeutic classes, health problems, problem classes, and locations.

4. There will be a feature to print out blanks of the specific data collection forms required to implement the *Rx* system.

5. Routines will be added to perform certain useful case-to-case computations and comparisons, including: chronological listing of multiple contacts by case; intervals between successive encounters by the same case; total number of encounters per case per period; and total number of drugs and cost of treatment per case over multiple encounters.

4.1.3. Additional Reports and Capabilities

1. Two reports will be added to handle data for multiple health problems, one which will produce and contrast profiles of the health problems contained in sets of encounters, and a second which will produce the current drug use analysis (RxDD Report 3) nested within specified health problem categories.

2. A longitudinally-oriented report will be added which will produce statistics on either health problems or drug use over time, where the rows will represent specific user-defined time periods (months, quarters, years), and columns would contain counts, sums, or rates of morbidity or drug use.

3. A report will be developed to contrast observed versus theoretical use of drugs for cases with health problems for which specific standard treatments have

been defined; contrasts could be based on quantities of drugs used, defined daily doses, or expenditures.

4. A report will be designed to allow the analysis of patterns drug use over a series of patient encounters, for example, successive visits to treat chronic problems or multiple-day inpatient hospitalizations; this report will include factors like number of visits per specified period of time, changing patterns of drugs and cost by visit, and regularity of visits.

5. The current report of key drug use indicators by location (RxDD Report 2) will be extended to allow sorting of locations by the value of any indicator, and print features will be added to flag outlier locations (those above and below a specified criterion, e.g., the 10%ile and 90%ile).

4.2. Preliminary Documentation Requirements

Much of the preliminary documentation for *Rx* will be an expansion of the User's Guide already prepared for RxDD. The documentation will be drafted at the same time the programming is being carried out. In order to get the new program into the field for application development as quickly as possible, this initial expansion of documentation will focus on:

- Adding to the existing RxDD User's Guide the program operations ("keystroke"), sections required for the new and revised features of *Rx;*
- Modifying the existing applications sections in the RxDD User's Guide so that they are suitable for use with *Rx*.

The production of detailed sections of the User's Guide describing specific new study and analysis methodologies to be introduced into *Rx*, such as the analysis of drug use in the treatment of chronic disease or sampling inpatient hospitalization records, will be deferred until an implementation of these specific applications is to take place.

4.3. Inventory of Likely Applications

During the project's first phase, while *Rx*'s programming and preliminary documentation are being completed, PRITECH will communicate with its existing country programs and with USAID/S&T Health to identify likely sites in which to demonstrate different types of *Rx* application. The output of this exercise will be a preliminary list of countries and potential study opportunities or interventions. The preliminary list will be reviewed with regard to such factors as importance of the proposed application, technical capabilities and needs of the local ministry of health, degree of country and mission interest, and availability of funds.

The output will be a short list of the six most likely countries in which to implement demonstration applications.

Once the short list is complete, *Rx* Project team members will make brief assessment visits to each country to (a) demonstrate *Rx* and its capabilities; (b) confirm the feasibility of applying the system for the intended application; (c) plan the specific activites required to carry out the application; and (d) schedule follow-up work. For some countries, information available to PRITECH may obviate the need for such assessment visits.

5. PHASE 2: APPLYING *Rx*

5.1. Range of Applications

It will be possible to apply *Rx* to guide the process of data collection, data management, and analysis, and to summarize major trends in drug use and other services for a broad range of health problems in a variety of clinical settings. The specific applications to be carried out will, of course, depend on the results of the inventory described in the preceding sections. Illustratively, the list might include applications similar to the following:

1. A Ministry of Health planning to launch in-service training activities for managing ARI could use *Rx* to perform retrospective analysis of prescribing practices for this health problem. Such an application might also include a prospective study of a sample of patient encounters to measure key features of physical examination (pulse, temperature, respiration rate), length and type of communication during consultation, and laboratory examinations. Information from such studies would help to identify the most important problem practices, and suggest training messages for overcoming them. *Rx* could be used in a similar way to evaluate the effectiveness of the training activities.

   Defining features:

   - *Disease focus: acute respiratory infections*
   - *Combination of retrospective analysis of practices with prospective data collection examining features of clinical examination*
   - *Use of the system to evaluate a training intervention*
   - *Integrates data on characteristics of physical examination and testing*
   - *Baseline results used to identify specific training messages*

2. A national CDD Program has managed to set up diarrhoea training units in a number of provincial and district hospitals, and now wishes to implement a routine system for monitoring case management practices. *Rx* could not only

be used to analyze and illustrate current practices; it could also be used to compare practices at each site with treatment norms in order to provide systematic feedback on performance to clinical staff.

Defining features:

- *Disease focus: diarrheal disease*
- *Retrospective sampling to illustrate current practice*
- *Routine period sampling for feedback on performance*

3. A national TB Control Program wants to learn about patterns of patient compliance with long-term tuberculosis treatment, both in order to better target outreach programs to patients who have high risk of dropout and also to be able to plan procurement of drugs in a more rational way. *Rx* can be used to profile a sample of cases for their demographic characteristics and patterns of compliance; the system can also be applied on an ongoing basis to monitor the impacts of patient outreach efforts, as well as to plan the quantities of drugs required by the program based on changing compliance patterns.

Defining features:

- *Disease focus: tuberculosis*
- *Sampling of multiple-encounter records rather than single encounters*
- *Within-patient compliance with drug treatment for chronic illness*
- *Planning disease-specific drug requirements in a vertical program*

4. A National Pharmacy Council wishes to launch a communications program for informing retail drug sellers about the best ways to handle customer requests for assistance with diarrhea and other priority health problems. *Rx* could be used to analyze the results of simulated purchase surveys for these problems, producing profiles of drugs sold and advice given. These results could be used to target problem behaviors to be dealt with through detailing activities.

Defining features:

- *Disease focus: diarrheal disease and 1 or 2 other key health problems*
- *Private sector retail orientation*
- *Simulated purchase survey used to collect data on drug use and communication during sales encounters*

5. A National Association of Mission Hospitals wishes to help members rationalize their overall system of drug procurement. *Rx* may be used to (a)

measure current prescribing practices and identify key clinical and economic inefficiencies; and (b) project theoretical needs based on standard norms of treatment and case mix trends. By taking into account current prescribing behaviors that deviate from the norms, the Association can coordinate training programs aimed at more rational prescribing with guidance for members in procuring a more rational profile of drugs. This should result in better quality of care and less waste.

Defining features:

- *Disease focus: full range of health problems*
- *Comparison of treatment norms to actual observed treatments*
- *Emphasis on economic as well as clinical efficiency*
- *Linkage of results from prescribing analysis to improving drug procurement procedures*

6. A Regional Director of Medical Services wishes to set up a new system of performance standards and supervision for personnel working in health centers and dispensaries. Monitoring of diagnostic and treatment practices for the 10 most common health problems will form a core component of this new system. *Rx* could be applied to sample visits at these facilities centers on a regular basis; identify facilities with practices substantially different from their peers; and provide graphical reports to be used during supervisory visits as tools for feedback and learning on the nature of these inappropriate practices.

Defining features:

- *Disease focus: 10 priority health problems*
- *Ongoing routine sampling for monitoring and supervision*
- *Identification of outliers on key performance indicators*
- *Focus on simple graphic reports as an intervention tool*

5.2 Carrying Out Country Applications

The country inventory and subsequent assessment visits described in Section 4 will determine where and for what purpose demonstration applications of *Rx* would be developed in different environments. Technical assistance needs, local staffing requirements, and local implementation costs will depend on the objectives of the application proposed and the circumstances in each country. A list of the types of personnel who might typically be required to implement *Rx* is included in Annex B.

The target for demonstrating country applications is six countries. At this point, the

following assumptions are appropriate:

- Applications that are essentially one-time studies will require 1-2 country visits of 4 weeks each by an *Rx* team member. Typically, a first visit would be used to work with local counterparts to design the study; fix data collection routines; adapt local drug and health problem lists; install, translate, and set up *Rx*; train local staff; and launch data collection. If needed, a second visit would be to assist in the analysis of results; prepare a report of findings; and make recommendations for follow-up.

- Applications that involve implementing *Rx* as a tool to be used on an ongoing basis within the routine operations of a ministry of health or other organization may require additional team member visits depending on what is attempted.

- On all visits, *Rx* team members should be counterparted with local personnel (e.g., public health physician, pharmacist, epidemiologist, health system manager) familiar with local clinical record keeping, diagnostic conventions, drug lists, and prescribing practices. Such counterparts may represent the MOH or other sponsoring institution, or in certain situations, may be contracted on a short-term basis.

- Each application will have requirements for goods and services such as office space, access to computer hardware, photo copying, transportation, data input, and data collection. Support for some of these may come from the ministry or other counterpart agency; some may come from existing projects; and some may need to be covered through the *Rx* project budget. The resources and requirements in each setting will be worked out during the assessment visits.

6. PHASE 3: COMPLETING *Rx*'S DOCUMENTATION

The *Rx* program and preliminary documentation will be produced in Phase 1, using the RxDD User's Guide as a foundation. The User's Guide will have two parts: The first part will cover installation of the system and operation of the program; the second part will address issues related to applying the *Rx* system. It is anticipated that following Phase 1, little additional work will be required in the first part of the Guide. There will, however, be ample room for improving and expanding the second part in light of the experiences of individual applications. This is a very important activity, because the greater the care taken to provide users with clear explanations and examples for applications problem solving, the more widely accessible and useful the Guide will be.

A number of applications issues have already been treated in the RxDD User's Guide. The recommended methodologies will be adapted to apply to the different types of application for

which *Rx* will be used, and the Guide will be filled out with lessons learned during the applications phase. Examples of methodological issues to be covered include:

- Designing samples of sites and patient encounters to meet the needs of different applications;
- Procedures for adapting local drug and health problem lists for use with *Rx*;
- Data collection and coding under different types of sampling plan;
- Training data collectors and program operators;
- Maintaining the system and its relevant databases over time.

7. LEVEL OF EFFORT AND BUDGET

Annex C presents for illustrative purposes the approximate level of effort and order-of-magnitude budget required to complete the development and application of *Rx*. The true level of effort and budget will depend in great part on the countries selected for applications, the nature of the particular applications selected, and the amount of external technical assistance needed to carry them out. (A more detailed budget will be prepared by the MSH Financial Office following initial response to this draft proposal.)

8. SUMMARY

This proposal presents the rationale for developing a system for the collection and analysis of drug use data. The proposed system, to be called the *Rx Drug Use Analysis System*, will consist of standardized procedures for characterizing drug use practices in a variety of settings and for a variety of different purposes, along with an integrated software package that will allow for the input, processing, and analysis of these data.

Rx will be based on, but will significantly extend the capabilities of, the existing RxDD Prescribing Analysis for Diarrheal Disease system. *Rx* will integrate both standardized and user-customizable database and graphics functions suitable for analyzing and reporting on drug treatment for a full range of health problems, as well as a range of other non-pharmaceutical services delivered during patient encounters.

The system will be developed in three phases: preparation of software and preliminary user documentation; implementation of demonstration applications; and revision of methodologies and documentation. During the applications phase, *Rx* will be applied to different health care management problems in six country settings. Lessons learned on sample design, data collection and coding, and personnel training will be incorporated into the system's

documentation.

The output of this proposed activity will be a practical, field-tested management tool, suitable for use by USAID in any country environment, that allows quantitative measurement of both the quality and cost of pharmaceutical health care services.

REFERENCES

1. Management Sciences for Health. ORSMAP pilot study in two provinces in Indonesia. December, 1989.

2. Najdi AN, Khuffash FA, R'Shaid WA, Ateeqi WA. Antibiotic misuse in a pediatric teaching department in Kuwait. Ann Trop Paediatr 8:145-148, 1988.

3. Lansang MA, Lucas Aquino R, Tupasi TE, Mina VS, Salazar LS, Juban N, Limjoco TT, Nisperos LE, Kunin CM. Purchase of antibiotics without prescription in Manila, the Philippines. Inappropriate choices and doses. J Clin Epidemiol 43:61-67, 1990.

4. Mann JM, Francis H, Davachi F, Baudox P, Quinn TC, Nzilambi N, Bosenge N, Colebunders RL, Piot P, Kabote N et al. Risk factors for human immunodeficiency virus seropositivity among children 1-24 months old in Kinshasa, Zaire. Lancet 1986; 2(8508): 654-7.

5. Management Sciences for Health. Child Survival Pharmaceuticals in Nepal: Opportunities for expanded Supply and Improved Use of Pharmaceuticals. Report to USAID Asia Near East Bureau, 1988.

ANNEX A: ILLUSTRATIVE SCHEDULE FOR DEVELOPING AND DEMONSTRATING *Rx*

	1991					1992											
ACTIVITY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PHASE 1																	
DETAILED TECHNICAL SPECIFICATIONS																	
CARRY OUT PROGRAMMING																	
DEBUG PROGRAM																	
PRELIMINARY DOCUMENTATION																	
INVENTORY OF LIKELY APPLICATIONS																	
LIST OF APPLICATION COUNTRIES																	
COUNTRY ASSESSMENT VISITS																	
PHASE 2																	
COUNTRY APPLICATION 1																	
COUNTRY APPLICATION 2																	
COUNTRY APPLICATION 3																	
COUNTRY APPLICATION 4																	
COUNTRY APPLICATION 5																	
COUNTRY APPLICATION 6																	
PHASE 3																	
INTEGRATE LESSONS IN DOCUMENTATION																	

ANNEX B: TYPICAL PERSONNEL REQUIRED TO IMPLEMENT *RX*

The type and level of commitment of local staff and the nature of external technical assistance needed to implement *Rx* in a new setting will depend on the existing human resources and health information infrastructure, previous local experience in carrying out similar activities, and the objectives of a particular application.

However, in a typical application of the *Rx* system as part of the routine operations of a Ministry of Health, there are certain staffing requirements that would need to be met for the system to function successfully. These requirements include:

a. a medical advisor or coordinator having general familiarity with pharmaceutical therapies and with the classification of health problems;

b. one or more persons familiar with the classification of pharmaceuticals and the organization of drug lists, including identification of appropriate therapeutic categories, recognition of generic equivalencies among products, and categorization of pharmaceuticals by concentration of active ingredient and dose form;

c. data collectors with either previous training or general aptitude in the recognition of pharmaceutical names, medical diagnoses, and associated abbreviations that are commonly used on medical records or prescriptions;

d. data entry personnel who have basic understanding of computer terminology, but no special expertise in programming, and with the capacity to be trained to recognize obvious errors in the coding of drug information;

e. a person familiar with the administrative and technical objectives of the analysis process of and the use to which the information coming from the system will be put, to supervise data collection, coding, and report preparation.

f. optionally, a person familiar with dBaseIII-compatible file structures and modest ability to program in the dBase language, who would be able to manipulate files, correct data problems, and prepare analyses in ways that are not permitted by the program.

ANNEX C: ILLUSTRATIVE SCOPE OF WORK

TASK	APPROXIMATE LEVEL OF EFFORT	APPROXIMATE MAGNITUDE OF COST
Phase 1: Developing the *Rx* software and preliminary system documentation		
Modifications and additions to RxDD	5-8 person-months programming	$15,000 for total subcontract
Production of preliminary documentation	10 person-weeks (6 professional, 4 support)	$20,000
Country assessment visits to 6 countries	6 person-weeks	$18,000 plus travel and per diem
Phase 2: Applying *Rx* in six different country settings		
Demonstration applications in 6 countries	average of 11 person-weeks per country (8 professional, 3 support)	$27,750 per country plus travel and per diem
Local implementation costs	depends on application and country situation	perhaps $4000 per country
Phase 3: Finalizing the system and documentation		
Modifications to *Rx* based on demonstration applications	(Included in subcontract in Phase 1)	(Included in subcontract in Phase 1)
Completion of documentation including applications	12 person-weeks (8 professional, 4 support)	$25,000